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Regional Variation and Articulation Rate in French

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Abstract

The present investigation deals with regional variation and articulation rate in French. The articulation rate in read speech and in spontaneous speech was examined in seven variants of French: Paris and Lyon in France; Tournai and Liège in Belgium; Geneva, Neuchâtel and Nyon in Switzerland. Results showed that Swiss speakers articulate at a lower syllable rate than French speakers (especially Parisian speakers) and Belgian speakers, independently of the speaking style (reading or conversation). This finding confirms that articulation rate varies regionally. Moreover, results revealed that extra-linguistic and linguistic factors, such as the speaker's age and gender, the speaking style, the utterance length and the articulation rate of the adjacent inter-pause chunk, also affect articulation rate.

Keywords
Articulation rate, French, regional variation, age, gender, speaking style, utterance length

Regional Variation and Articulation Rate in French

1. Introduction

Articulation rate (henceforth AR) is one of the most commonly used variables for measuring the tempo of a given utterance. It is also the variable on which listeners mainly rely to perceptually evaluate the pace at which an utterance is produced (Koreman, 2006; Lane & Grosjean, 1973). In fact, AR refers to the number of units (e.g. syllables, phones) produced in a specific time, excluding pauses. It is generally expressed in syll/sec (Grosjean & Deschamps, 1975) or in ms/syll (Miller, Grosjean & Lomanto, 1984; Quené, 2008).

The factors that affect AR are numerous (Quené, 2008; Schwab, 2007). For example, it is known that the speakers' age and gender have an influence on AR: young speakers articulate faster than older speakers, and males articulate faster than females (Jacewicz, Fox, O'Neill & Salmons, 2009; Quené, 2008; Schwab & Racine, 2012; Smith, Wasowicz & Preston, 1987; Verhoeven, De Pauw & Kloots, 2004). AR also varies as a function of the speaking style. It has been claimed that AR is faster in reading than in conversation (Grosjean & Deschamps, 1975; Lucci, 1983). However, some studies present an inverse tendency (Avanzi, Schwab, Dubosson & Goldman, 2012; Crystal & House, 1990; Woehrling, Boula de Mareüil & Adda-Decker, 2008). Moreover, it has been shown that the length of the utterance affects AR (Bartkova 1991; Quené, 2008): the longer the utterance, the faster the AR[1]. Finally, AR may depend on the speaker's regional variant (e.g. Jacewicz, Fox & Wei, 2010, for American English; Verhoeven et al., 2004 and Quené, 2008, for Dutch). As far as variants of French are concerned, AR is still an issue under debate.

Native speakers of French from France tend to perceive Belgian and Swiss French speakers' tempo as slower than their own. Such a perceptual stereotype is reported in almost all the studies and handbooks describing the French spoken in Belgium and Switzerland (Klinkenberg, 1999; Knecht & Rubattel, 1984; Remacle, 1969; Singy, 2004; Warnant, 1997). Yet, to our knowledge, the question whether Belgian and Swiss speakers of French actually speak slower than speakers of Standard French[2] is still unanswered. Many scholars have addressed this issue by comparing the AR of native French speakers from different French-speaking areas. As described below, their results have led to contradictory conclusions.

As far as the Belgian variants are concerned, little work has been dealing with temporal variables (see nevertheless Bardiaux, Simon & Goldman, 2012; Boula de Mareüil, Adda-Decker, Woehrling, Bardiaux & Simon, 2012; Goldman & Simon, 2007; Schwab, Avanzi, Goldman, Dubosson, Bardiaux, in press). Taken together, these studies show that, contrary to common belief, the AR of Belgian speakers of French[3] does not physically differ from the AR of Standard French speakers. Yet, it is important to note that these studies, except Boula de Mareüil et al. (2012), were performed on read speech only.

Regarding the Swiss variants, studies are less recent and more numerous, and have led to more variable results. Schoch, Jolivet & Mahmoudian (in Mahmoudian & Jolivet, 1984) compared the AR in conversation of 40 speakers from the Vaud canton in Switzerland with the AR of 30 Parisian speakers, and found no significant differences. These results are confirmed by Sertling

[1] What Quené (2008) calls the "anticipatory effect".
[2] The notion of Standard French will not be addressed in this paper. For our purpose, Standard French refers to the variant of French transmitted by the media, and spoken in the non-peripheral parts of the Oïl and the Franco-Provencal areas of Metropolitan France (Boula de Mareüil, Adda-Decker, Woehrling, Bardiaux & Simon, 2012; Lyche, 2010; Sertling Miller, 2007; Racine, Schwab & Detey, 2013).
[3] The Belgian speakers of these studies originate from Tournai (a city located on the Belgium/France border), Brussels (the capital of Belgium), Liège and Gembloux (two cities located in the East side and in the center of the French-speaking part of Belgium).

Miller (2007), who reported no significant differences between the AR (in reading) in six Swiss speakers (3 males and 3 females from Nyon, a city located in the Vaud Swiss canton; aged from 19 to 35 years) and six speakers originating from the various cities located in the Oïl area of France (3 males and 3 females aged from 22 to 40 years). Goldman & Simon (2007) compared the AR in reading of 11 speakers from Lyon (in France) and 12 speakers from Tournai (in Belgium) with the AR of 12 speakers from Nyon (in Switzerland) and 12 speakers from Liège (in Belgium), and found no significant differences between what they considered as the Standard variants (Lyon and Tournai) and the regional variants (Nyon and Liège), but no details were given regarding the differences between Lyon and Nyon.

On the other hand, the conclusion that the AR in the Swiss variants (i.e. Vaud) is similar to the French Standard variants is not supported by recent studies (Avanzi et al., 2012; Boula de Mareüil et al., 2012; Schwab & Racine, 2012; Schwab et al., in press). Taken together, the results show significant differences between speakers of Standard French and speakers from Switzerland (Geneva, Nyon and Neuchâtel): Swiss speakers articulate at a lower syllable rate than Standard French speakers, in read speech as well as in conversation. It was also found that Swiss speakers present a slower AR than Belgian speakers, at least in read speech.

The discrepancies we observe in the reported studies can be explained by the fact that the speakers' age and gender were not systematically controlled, or, if controlled, were not considered as factors in the statistical analyses (e.g. Goldman & Simon, 2007; Sertling Miller, 2007), despite their known impact on AR. Moreover, most of the studies only examined read speech (e.g. Sertling Miller, 2007), while others also took into account conversational speech (e.g. Avanzi et al., 2012).

2. Research questions

While Avanzi et al. (2012) examined the AR of some Swiss regional variants and Parisian French in reading and conversation, and Schwab et al. (in press) studied the AR of some Swiss, Belgian variants and Parisian French in reading only, we investigate, in the present research, the AR of some Swiss, Belgian regional variants and Parisian French in reading and conversation. More precisely, the present investigation focuses on the effect of the speaker's regional variant on AR in French by taking into account not only extra-linguistic factors such as the speaker's age and gender but also linguistic factors, such as the length of the utterance, the articulation rate of the preceding utterance and the speaking style. Given that the read speech may involve more standardized productions, and thus might hide the effects of the regional variant (Simon, 2004), we consider read speech as well as spontaneous speech.

More specifically, our research questions are the following: 1) Do Swiss and Belgian speakers of French articulate slower than Standard French speakers? 2) Is AR different between regional variants within the same country? 3) Which role do gender and age play for AR? 4) To what extent do linguistic factors such as the length of the utterance and the speaking style have an effect on AR? 5) Is the articulation rate related to the articulation rate of the preceding utterance?

3. Method

The material we used consisted in speech samples extracted from the PFC database (Durand, Laks & Lyche, 2002, 2009). The selection (regional variants and speakers) and the processing (transcription, alignment, labelling, etc.) of these speech samples were carried out for a project dealing with stylistic and regional variation of European French accentuation and phrasing (see Avanzi, 2013, for a detailed description).

3.1 Selection of the speech samples

As far as the variants from France were concerned, we selected speech samples from Paris and Lyon, since these variants are considered to be representative of Standard French (e.g. Boula de Mareüil et al., 2012; Goldman & Simon, 2007; Woehrling & Boula de Mareüil, 2006; Woehrling et al., 2008). Regarding the Belgian and Swiss variants, we considered the variants which were examined in the studies mentioned in the Introduction: Tournai and Liège (in Belgium), Neuchâtel and Nyon (in Switzerland). We also added Geneva (in Switzerland), which is located at the border between Switzerland and France. The selection of these variants was also motivated by the results of perceptual studies conducted on Belgian variants (Bardiaux et al., 2012; Boula de Mareüil & Bardiaux, 2011) and Swiss variants (Racine, Schwab & Detey, 2013), which revealed that the pronunciation of the speakers from Tournai and Geneva was perceived as closer to the standard variants of French than the pronunciation of the speakers from Liège, Neuchâtel and Nyon.

We selected the productions of eight speakers from Paris (F-PA) and Lyon (F-LY) in France; Geneva (S-GE), Neuchâtel (S-NE) and Nyon (S-NY) in Switzerland; Tournai (B-TO) and Liège (B-LI) in Belgium. All speakers were born and raised in the city where they were recorded. Care was taken to select four females and four males in each of the seven variants, and to control the speaker's age across the variants. As can be seen in Table 1, analyses of variance (ANOVA) showed no differences between the speakers' age in the seven varieties ($F(6, 42) = 0.25$, n.s.), between males and females ($F(1, 42) = 0.002$, n.s.) and between males and females across the seven variants ($F(6, 42) = 0.14$, n.s.).

Table 1. *Age range and age mean value (standard deviation) of the speakers of the seven regional variants.*

Regional variant	Age range (years)	Age mean value (s.d.) (years)
F-PA	24-86	50.38 (22.36)
F-LY	21-74	42.25 (20.37)
S-GE	21-61	41.38 (17.95)
S-NE	25-78	52.5 (24.11)
S-NY	30-70	46.25 (17.09)
B-TO	19-82	43.63 (26.00)
B-LI	21-76	47.75 (24.14)

Speakers were recorded in a reading task and in a semi-directed sociolinguistic interview (hereafter referred to "conversation"). In the reading task, speakers were instructed to carefully read a journalistic text (containing 22 sentences and 398 words). In the conversation, speakers were asked to give some biographic and linguistic information and to answer some questions about their everyday life (family, job, leisure, etc.). The recordings were performed using the PFC protocol (Durand et al., 2002, 2009).

3.2 Annotations

As mentioned above, the material we used in this study has been initially prepared within the framework of a project dealing with prosodic variation in European French. For the aim of this project, each of the productions (i.e. the entire read text and 3 minutes of the conversation) was first orthographically transcribed with the Praat software (Boersma & Weeninck, 2013). Transcriptions were then semi-automatically aligned in phones, syllables and words with EasyAlign scripts (see Goldman, 2011, for a detailed description of the tool and Goslin, Content, Goldman & Frauenfelder, 1999, for the implementation of the syllabification rules). Alignments were manually checked and corrected by inspecting waveforms and spectrograms (i.e. boundary adjustments, schwa deletions or insertions).

Non-transcribed segments, such as interventions from the interviewer, overlapped speech, or laughs were coded with specific symbols in order to be excluded from the analyses. As for the identification of silent pauses, no threshold was adopted, in order to avoid missing any short pauses realized at fast speech rates. Disfluent segments (false starts, breaks in the syntactic structure, elongations due to a hesitation, "euh", etc.) were identified as described in Avanzi, Goldman, Lacheret-Dujour, Simon & Auchlin (2007).

3.3 Data analysis

For each of the 112 productions (8 speakers x 7 variants x 2 speaking styles), we counted the number of syllables in the inter-pause chunks, excluding the syllables that have been labelled as a disfluency[4] from the calculation. Note that, since the speech samples were transcribed and labelled following the procedure adopted in Avanzi (2013), the syllables were phonetic (i.e. actually realized) and not canonical.

We excluded inter-pause chunks of less than three syllables (N = 421). Given that the AR of the preceding inter-pause chunk was included as a predictor, we also excluded inter-pause chunks that were not preceded by another chunk (for example, the first chunk of the production, or a chunk preceded by a non-transcribed segment) (N = 971), leading to 4696 inter-pause chunks (2570 in reading and 2126 in conversation).

AR for each inter-pause chunk (and for the preceding inter-pause chunk) was computed in milliseconds per syllable (Miller, Grosjean & Lomanto, 1984; Quené, 2008). In other words, we calculated the mean duration of the syllables (in milliseconds, ms) within the inter-pause chunk.

Data were analyzed by means of a generalized linear model (with repeated measures; Generalized Estimating Equations, GEE[5]) with syllabic duration as a dependent variable. A summary of all factors and interactions entered into the initial model (Model I) is presented in Table 2. The speaker's regional variant (B-LI, B-TO, S-GE, S-NE, S-NY, F-PA, F-LY), gender (male/female) and age were used as extra-linguistic factors. The linguistic variables used in this study were speaking style (reading/conversation), number of syllables within the inter-pause chunk (i.e. the utterance length; NrSyll) and syllabic duration of the preceding inter-pause chunk (PrevDurSyll)[6]. The variables Age, NrSyll and PrevDurSyll were centralized to their respective mean value. Only the interactions that interested us were entered into the model. Namely, besides all two-way interactions involving the regional variant (i.e. the central variable of this study), we entered the two-way interaction Speaking Style x Age and the three-way interaction Regional variant x Speaking Style x Age, in order to examine whether the effect of age was similar in reading and in conversation for all regional variants. We also considered the two-way interaction Speaking Style x Gender and the three-way interaction Regional variant x Speaking Style x Gender, in order to examine whether the differences between males and females were similar in reading and in conversation in all regional variants. Moreover, we were interested in the interactions between the extra-linguistic variables, (i.e. the two-way interaction Age x Gender and the three-way interaction Regional variant x Age x Gender). Regarding the interactions between linguistic variables, we entered the two-way interaction between Speaking style x NrSyll, as well as the three-way interaction Regional variant x Speaking style x NrSyll.

[4] Although disfluent syllables only represent 5.05% of the syllables of the corpus (0.55% in reading and 9.63% in conversation), they were not equally distributed in the different regional variants (χ^2 (6, n = 72174) = 122.09, p < .001). In order to avoid this different distribution being responsible for the differences in articulation rate between the regional variants, we excluded them for the calculation of articulation rate.

[5] GEEs represent an extension of the generalized linear model (GLM) to account for correlated data (Ghisletta, & Spini, 2004).

[6] Quené (2008) also included as a predictor the sequential position of the phrase within the interview. However, given that our spontaneous material is an excerpt of the larger interview, it would not be relevant in our study.

We also considered the two-way interaction between Speaking style x PrevDurSyll, as well as the three-way interaction Regional variant x Speaking style x PrevDurSyll. We also entered the two-way interaction between NrSyll x PrevDurSyll, as well as the three-way interaction Regional variant x NrSyll x PrevDurSyll. Finally, we were interested in the three-way interaction between the linguistic variables (i.e. the interaction Speaking style x NrSyll x PrevDurSyll).

In the final model (Model II, see Table 2), we retained only the factors showing an effect or involved in a significant interaction, and the significant interactions. Bonferroni corrections were applied when doing pairwise comparisons between levels of a given factor.

Table 2. *Linguistic, extra-linguistic factors and interactions entered into Model I and into Model II.*

Model I	**Model II**
Extra-linguistic factors	
Regional variant	√
Gender	√
Age	√
Linguistic factors	
Speaking style	√
NrSyll	√
PrevDurSyll	√
Interactions	
Regional variant x Gender	√
Regional variant x Age	√
Regional variant x Speaking style	
Regional variant x NrSyll	√
Regional variant x PrevDurSyll	
Speaking style x Age	√
Regional variant x Speaking Style x Age	
Speaking style x Gender	
Regional variant x Speaking style x Gender	
Gender x Age	
Regional variant x Gender x Age	√
Speaking style x NrSyll	√
Regional variant x Speaking style x NrSyll	√
Speaking style x PrevDurSyll	
Regional variant x Speaking style x PrevDurSyll	
NrSyll x PrevDurSyll	√
Regional variant x NrSyll x PrevDurSyll	
Speaking style x NrSyll x PrevDurSyll	

In the next section, we only discuss the effect of the factors and the interactions entered into Model II, and we do not comment the non-significant factors and interactions entered into Model I. For the sake of clarity, we divide the next section into two parts, although all factors and interactions were entered into the same model.

The syllabic duration values presented in the following section are the values predicted by the GEE model[7]. The presentation of the predicted values instead of the real values allows us to

[7] The predicted values were calculated from the GEE regression equation. The equation had the following shape: $\hat{y} = \beta_1 x_1 + \beta_2 x_2 + \ldots + \beta_p x_p + \beta 0$, where x_1, x_2, …, x_p represented the factors entered into the model (see Table 2) and $\hat{y}$ the predicted syllabic duration. The model was validated with the inspection of the

isolate and to visualize, by means of regression lines, the effect of one (or two) particular variable(s) holding the other variables constant[8]. To our mind, given the large number of variables and interactions entered into the model, the presentation of the predicted values makes the understanding and the interpretation of the results easier.

4. Results and discussion

4.1 Regional variant, Speaking style, Gender and Age

Figure 1 presents the predicted mean syllabic duration (in ms; averaged across gender and speaking styles) as a function of the regional variant. As can be seen, we observe an effect of regional variant (Wald χ^2 (6) = 85.94, p < .001)[9]. Post-hoc analyses show that the difference between the two variants from France (F-PA and F-LY) is not significant (p > .05). Regarding the variants from Switzerland, the three of them, which do not differ from each other (p > .05), present a longer syllabic duration (i.e. a slower AR) than F-PA (p < .01). Interestingly, contrary to S-NY and S-NE (p > .05), S-GE presents a statistically similar syllabic duration to F-LY (p > .05).

As for the variants from Belgium, the syllabic duration is similar in B-TO and B-LI (p > .05). B-TO and B-LI do not differ from the two variants from France (p > .05), but they present a shorter syllabic duration than the Swiss variants (p < .05), except for B-TO which shows a similar syllabic duration to S-GE (p > .05).

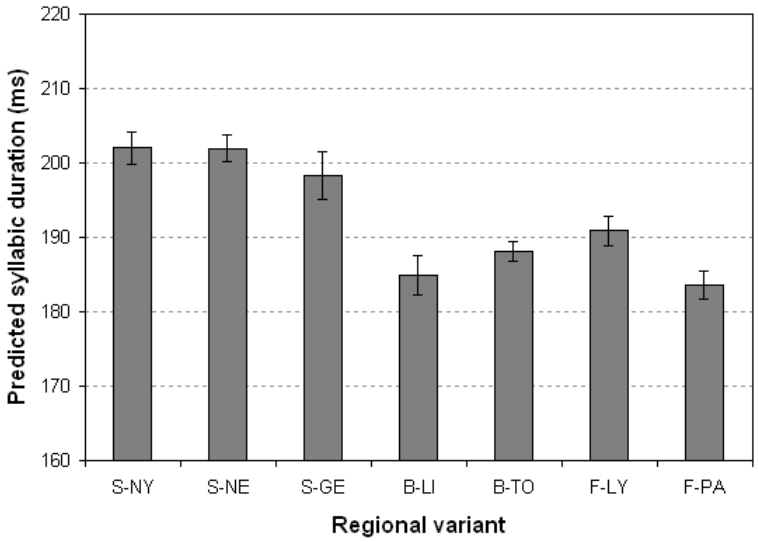

Figure 1. *Predicted syllabic duration (in ms) as a function of the regional variant. Error bars are standard error of the mean.*

Results also show an effect of speaking style (Wald χ^2 (1) = 12.93, p < .001): the syllabic duration is shorter in conversation (189 ms) than in reading (197 ms)[10]. This difference is

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normality and homoscedasticity of the residuals, as well as the lack of any relationship between the residuals and the predicted values.

[8] For the categorical variables "Variant", "Gender" and "Speaking style", the means were predicted holding the variables "Age", NrSyll" and "PrevDurSyll" constant at their mean (Age = 46.23 years; NrSyll = 11.5 syllables; PrevDurSyll = 195 ms).

[9] Considering the mean syllabic duration of the 8 individual speakers in each regional variant, we found the variance to be not different across the 7 regional variants (F(6, 49) = 0.48, n.s.).

[10] Note that there is a relationship between the speakers' mean AR in reading and in conversation (N = 56; r = 0.69, p < .001), which suggests, as reported in Jacewicz et al. (2010), "the existence of the same underlying cause or a common motor control mechanism for speaker-specific rate of speech delivery" (p. 844).

independent of the regional variant, since there was no interaction between Regional variant x Speaking Style.

Moreover, the results not only show that syllable durations are shorter in males (i.e. a faster AR) than in females (188 ms and 198 ms, respectively; Wald χ^2 (1) = 33.06, p < .001), but also that the differences between males and females vary as a function of the regional variant (Wald χ^2 (6) = 35.23, p < .001). Post-hoc analyses show that the syllabic duration is shorter for males than for females in F-PA (p < .001) and in B-TO (p < .001), but not in the other variants (p > .05).

In addition, we observe an effect of age: the older the speaker, the longer the syllabic duration (Wald χ^2 (1) = 274.69, p < .001). However, this effect is not the same across the different variants (Wald χ^2 (6) = 47.69, p < .001). Figure 2 presents the predicted syllabic duration (in ms) as a function of regional variant and age. As can be seen, the impact of age appears to be more important (i.e. the slopes are steeper) in the Swiss variants and in F-LY than in the Belgian variants and in F-PA[11]. Note that gender modulates the effect of age in some variants (Wald χ^2 (7) = 18.85, p < .001). Indeed, while age has a similar influence in males and females in the three Swiss variants (p > .05), it has a greater influence in males than in females in F-LY and B-TO (p < .05), but a weaker influence (although not significantly) in males than females in F-PA and B-LI (p > .05).

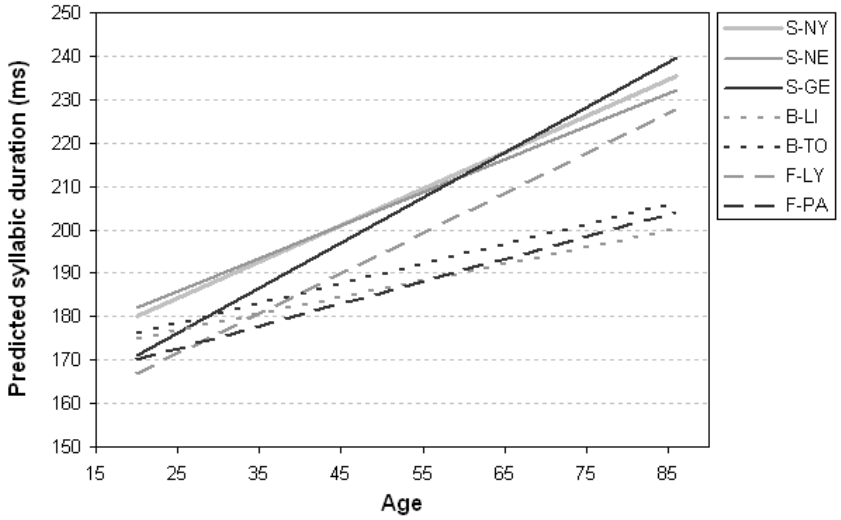

Figure 2. *Predicted syllabic duration (in ms) as a function of regional variant and age.*

Furthermore, it is worth pointing out the presence of an interaction Speaking style x Age (Wald χ^2 (1) = 6.52, p < .05). Figure 3 presents the predicted syllabic duration (in ms) as a function of speaking style and age. As can be seen, the effect of age is more important in reading than in conversation, independently of the regional variant[12]. In other words, the difference between the syllabic duration in reading and in conversation increases with age.

[11] The slopes are (in descending order); 1.04 for S-GE; 0.92 for F-LY; 0.84 for S-NY; 0.76 for S-NE; 0.51 for F-PA; 0.46 for B-TO; 0.38 for B-LI.
[12] The slopes are 0.82 for reading and 0.58 for conversation.

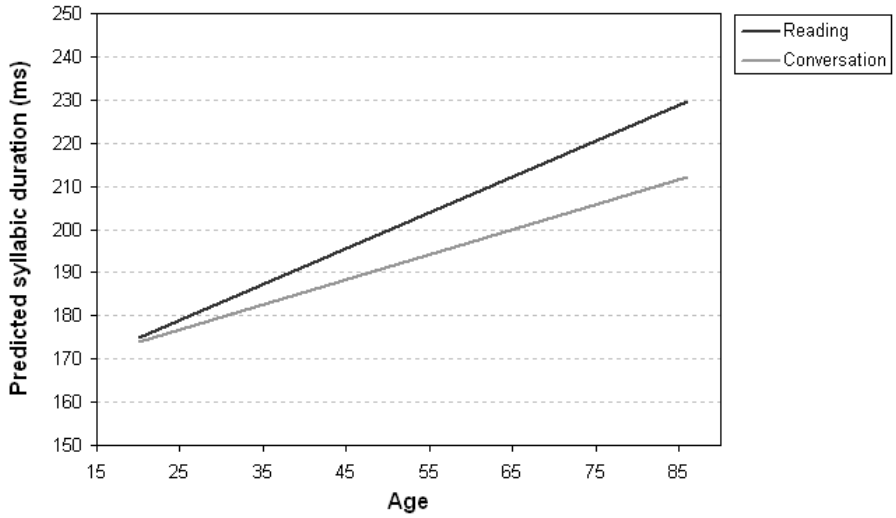

Figure 3. *Predicted syllabic duration (in ms) as a function of speaking style and age.*

4.2 Regional variant, Speaking style, NrSyll and PrevDurSyll

Figure 4 presents the predicted syllabic duration (in ms) as a function of NrSyll (number of syllables within the inter-pause chunk) and speaking style[13]. We observe an effect of NrSyll (Wald χ^2 (1) = 600.99, $p < .001$): the longer the inter-pause chunk, the shorter the syllabic duration. However, as can be seen in Figure 4, this effect is stronger in conversation (i.e. the slope is steeper) than in reading[14] (Wald χ^2 (1) = 9.91, $p < .01$).

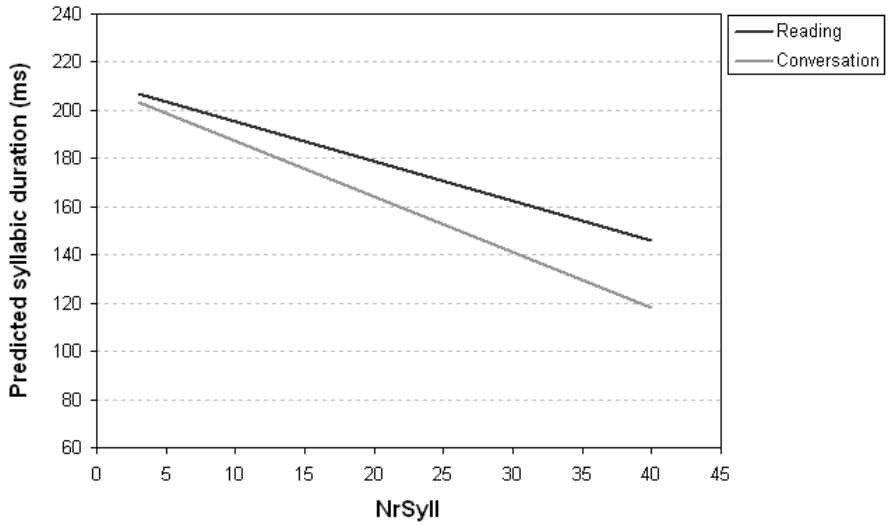

Figure 4. *Predicted syllabic duration (in ms) as a function of NrSyll (number of syllables within the inter-pause chunk) and speaking style.*

Figure 5 presents the predicted syllabic duration (in ms) as a function of NrSyll (number of syllables within the inter-pause chunk) and speaking style, for each of the seven regional

[13] The mean NrSyll was 11.74 for reading and 11.23 for conversation. The presence of some long inter-pause chunks (more than 30 syllables) was due to the fact that inter-pause chunk boundaries were determined by a silent pause, and not by a filled pause. These data are in agreement with Grosjean & Deschamps (1975), who found an median inter-pause chunk length of 12 syllables (range: 1-60 syllables).
[14] The slopes are -1.22 for reading and -1.71 for conversation.

variants. We observe first that the effect of NrSyll is not similar across all variants[15] (Wald χ^2 (6) = 22.72, p < .001).

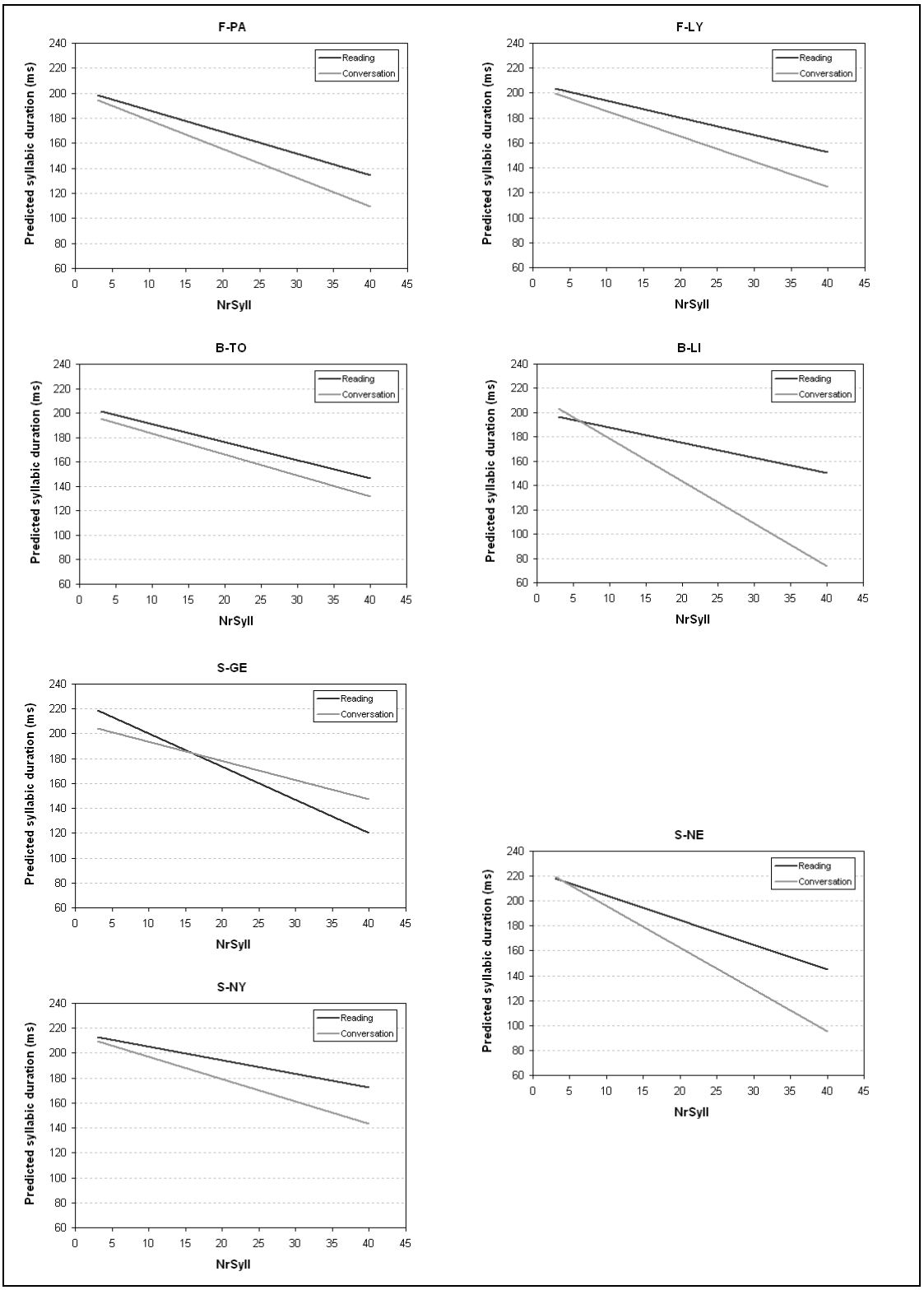

Figure 5. *Predicted syllabic duration (in ms) as a function of NrSyll (number of syllables within the inter-pause chunk) and speaking style, for each of the seven regional variants.*

[15] The slopes are in average (in ascending order): -1.97 for S-NE; -1.76 for B-LI; -1.56 for S-GE; -1.48 for F-PA; -1.25 for F-LY; -1.18 for B-TO; -1.07 for S-NY.

Second, and more interestingly, not all variants show similar differences between the NrSyll effect in reading and in conversation[16] (Wald χ^2 (6) = 13.83, $p < .05$). The NrSyll effect is stronger in conversation than in reading in F-LY, B-LI and S-NE ($p < .05$), while we observe the inverse difference in S-GE (although not significantly; $p > .05$) and a similar NrSyll effect in reading and conversation in F-PA, B-TO and S-NY ($p > .05$). The differences between the variants are hard to explain, but highlight the necessity to take into account the inter-pause chunk length in the study of the temporal variables.

Finally, it is important to note the effect of PrevDurSyll (Wald χ^2 (1) = 49.72, $p < .001$): the longer the syllabic duration of the inter-pause chunk, the longer the syllabic duration of the following inter-pause chunk. In other words, the AR of an utterance is influenced by the AR of the previous utterance.

Interestingly, the effect of PrevDurSyll is modulated by the effect of NrSyll (Wald χ^2 (1) = 34.70, $p < .001$): the effect of PrevDurSyll is weaker when NrSyll increases. In other words, the slower the AR of the inter-pause chunk, the slower the AR of the following inter-pause chunk. But the shorter the inter-pause chunk is, the stronger this relationship will be.

5. General discussion

The present study aimed at examining the effect of the speaker's regional variant on AR by taking into account not only extra-linguistic factors such as the speaker's age and gender, but also linguistic factors, such as speaking style, length of the utterance and the AR of the preceding utterance. Results showed that the Swiss speakers present a slower AR than the Parisian speakers and that the speakers from Geneva and Lyon show a similar AR. Belgian speakers, contrary to common belief, do not produce a lower syllable rate than speakers from Paris or Lyon, but do produce a higher syllable rate than Swiss speakers from Nyon and Neuchâtel. Therefore, these findings empirically confirm the perceived slower tempo of Swiss speakers, in comparison with French speakers (especially with Parisian speakers).

Results also revealed an effect of speaking style: AR is faster in conversation than in reading. These results are in agreement with observations made for English (Crystal & House, 1990; Jacewicz et al., 2010). However, it is important to note that the differences we have observed between the regional variants do not depend on the speaking style.

As far as the extra-linguistic variables are concerned, results showed that males articulate at a higher syllable rate than females, especially in Paris and in Tournai, and that AR decreases with age, especially in the Swiss variants and in Lyon (France). Moreover, it seems that age has a different influence in males and in females across the seven variants. More interestingly, results also showed that the difference between the AR in reading and in conversation increases with age. Such a finding –also found by Jacewicz et al. (2010)– might be explained by the different visual acuity between young and older speakers (i.e. older speakers might experience subtle visual deficits, cf. Paterson, McGowan & Jordan, in press) or by their different attitude towards reading (i.e. more careful reading aloud for older speakers).

As to the linguistic variables, results indicated an effect of the utterance length: the longer the utterance, the faster the AR (as in Dutch; Quené, 2008, but contrary to American English; Jacewicz et al., 2010). The stronger effect in conversation than in reading might suggest that AR is more stable in reading than in conversation. Results also showed that the effect of the utterance length in reading and in conversation varies as a function of the regional variant. These differences are difficult to explain, but highlight the necessity to take into account the

[16] The slopes are for reading and conversation, respectively: -1.27 and -1.70 for F-PA; -1.01 and -1.50 for F-LY; -1.10 and -1.26 for B-TO; -0.93 and -1.71 for B-LI; -1.97 and -1.14 for S-GE; -1.47 and -2.48 for S-NE; -0.81 and 1.32 for S-NY.

utterance length in the study of the temporal variables. Finally, results revealed that there is a relationship between the AR of two adjacent inter-pause chunks (i.e. the slower the AR of an inter-pause chunk, the slower the AR of the following inter-pause chunk), and that this relationship is stronger when the length of the inter-pause chunk decreases. Despite the high variability that can be found in the AR of different utterances within the same text, or even within an utterance (Miller et al., 1984), a link seems to exist between the AR of two adjacent inter-pause chunks, suggesting the presence of a higher level (i.e. supra-phrasal) effect on AR.

How can the AR differences between the regional variants, between reading and conversation, between males and females and between young and older speakers be explained? Following Quené (2008) and Jacewicz et al. (2010), one explanation might lie in the utterance length. Consequently, we ran a model with the utterance length (NrSyll) as a dependent variable and with the same predictors and interactions as in the AR analysis. Despite the presence of an effect of regional variant, the NrSyll differences observed in the variants[17] do not explain the AR differences, since the variants with faster AR are not systematically those with long utterances. NrSyll does not account for the AR differences between reading and conversation either, as reading shows longer utterances than conversation[18]. Moreover, NrSyll cannot explain the AR differences between males and females, as no effect of gender on NrSyll was found[19]. Finally, the effect of age on AR is not due to NrSyll differences between young and older speakers, since no effect of age on NrSyll was found[20]. Therefore, we can conclude that the utterance length is not responsible for the AR differences we have observed in this study.

In a future investigation, we intend to explore other possible explanations of the differences between the variants. One explanation can be found in the realization of secondary stressed syllables in the different variants. It has been shown that Swiss speakers manifest a stronger tendency to produce secondary stress (i.e. in initial and penultimate position) than Parisian speakers (Avanzi et al., 2012). Besides, the fact that Swiss speakers realize these secondary stressed syllables with a longer duration (Boula de Mareüil et al., 2012) could, partially, explain their slower AR. Finally a controlled study of the perception of speech rate in the different French, Swiss and Belgian regional variants would allow us to determine whether, for example, Belgian regional variants are really perceived as slower than the Standard French variants, while their articulation rate is indeed similar.

6. Conclusion

The present investigation confirms that the speaker's regional variant is an important factor determining the articulation rate in French. Indeed, it brings empirical evidence to the impression that Swiss speakers articulate at a lower syllable rate than speakers of Standard French (with the exception of the speakers from Geneva, who, contrary to speakers from Nyon or Neuchâtel, are not slower than speakers from Lyon), but does not empirically support the common belief that Belgian speakers articulate at a lower syllable rate than speakers of Standard

[17] The utterance length (in syllables) is (in descending order): 12.71 for F-LY; 12.17 for S-NY; 11.82 for F-PA; 11.53 for B-TO; 11.33 for B-LI; 11.14 for S-NE; 10.50 for S-GE (effect of regional variant: Wald χ^2 (6) = 36.74, $p < .001$). Post-hoc analyses ($p < .05$) showed that S-GE presents significantly shorter utterances than F-LY and S-NY, and that S-NE presents shorter utterances than F-LY.

[18] The utterance length (in syllables) is 12.07 for reading and 11.13 for conversation (effect of speaking style: Wald χ^2 (1) = 11.21, $p < .01$). Moreover, an interaction Variant x Speaking style is observed (Wald χ^2 (6) = 29.23, $p < .001$). It comes from B-LI, the only regional variant with significantly longer utterances in reading than in conversation ($p < .05$).

[19] Nevertheless, an interaction Variant x Gender was found (χ^2 (6) = 43.06, $p < .001$). The difference between males and females is not significant, except in F-LY where males produced longer utterances than females ($p < .05$) and in S-NY, where females produced longer utterances than males ($p < .05$).

[20] Nevertheless, although "Age" was involved in a three-way interaction Variant x Gender x Age (χ^2 (7) = 19.80, $p < .01$), and in a three-way interaction Variant x Speaking style x Age (χ^2 (7) = 18.27, $p < .01$), it does not explain the AR differences.

French. Importantly, this investigation also reveals that the effect of the regional variant on articulation rate is not sensitive to speaking style. Moreover, the speaker's age and gender are confirmed to influence articulation rate, but not in a similar way across all variants: articulation rate decreases with age, more strongly in the Swiss and Lyon variants than in Paris and Belgian variants, and males produce a higher syllable rate than females in Paris and Tournai. Finally, the utterance length and the articulation rate of the adjacent utterance also appeared to have a significant effect on articulation rate. Further work is still needed to explain the origins of the regional differences highlighted in this investigation.

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